

NOTES ON THE DEVELOPMENT OF *DRASTERIA ERECHTEA* (Cramer).*

PLATES IV AND V.

BY F. M. WEBSTER.

The preparatory stages of this species have been studied by Professor French,[†] and I have no expectation of adding anything to his careful and painstaking work. Mr. M. V. Slingerland[‡] has also reared the species from the egg, but his studies relate more especially to the characters of the adults and those of closely allied species and varieties. My own studies were begun with the idea of watching the individual development of the young as closely as I was able, gleaning any points regarding such development as was possible, and which had not been already recorded. I can hardly claim that the work was premeditated, as, but for what might be termed a bit of carelessness, the study would have never been commenced.

September 24th, I captured a female moth and, killing her as was supposed, placed her on the setting board. On the following day it was found that she had revived and though unable to release herself, had struggled about and completely ruined herself so far as a desirable specimen was concerned (which I later had cause to regret), and, in the meanwhile, deposited a number of eggs. As she was captured among grass and clover, it was probably during the performance of that duty that she fell into my hands, and the labor was finished while pinned upon the setting board.

The eggs were of a malachite green, as described by Professor French, but I found them somewhat more flattened at the poles than he has described, though the drawings made from alcoholic specimens hardly represent them as they appear when freshly deposited, the flattening at the poles being closely illustrated by the appearance of the upper end in the middle of the three illustrations on Plate IV, the eggs from which drawing was made being those deposited by an unmated female.

The eggs were placed near a bunch of grass, transplanted to the vivarium, but they hatched while no one was about the insectary to ob-

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[†]*Papilio*, Vol. IV, pp. 148-149.

[‡]*Insect Life*, Vol. V, pp. 87-88.

serve them, and it was not until several days that the young were found on the blades of timothy. On October 10th, however, they were found, and at that time had precisely the appearance that French ascribes to the larvæ before first moult, viz., the two extremities of the body were of a pinkish color while the intermediate portion was of a greenish hue, which I ascribed at the time to the color of the food showing through the almost transparent walls of the body. In this case, I believe the egg stage was about twelve days, instead of five days, as observed by Professor French, as the eggs had not hatched on October 8th, and the larvæ did not show the reddish stripes, which indicate the period following first moult, on October 12th, but did show them on the 14th. This would give an egg period of twelve days, and the larval period to first moult five or six days, instead of three, as Professor French found it to be at Carbondale, Illinois. Was this difference due to latitude or to the advanced season when my observations were made? This will certainly be an interesting question. The very young larvæ have every appearance of belonging to the Geometridæ, and when feeding on the blades of grass, eat the substance of the blades only, leaving the veins and the epidermis almost intact. After the first moult they begin to eat through the leaves and along the edges, causing cleanly cut notches. The grass plant was now enclosed by a glass cylinder placed in a vertical position, and the larvæ, by jerking the posterior part of the body while hanging to the grass blades by the feet, threw the excreta away from them, and it could be observed in abundance on the inside of the glass, where it had been caught and held by the moisture collected there. If in any way disturbed, however, they hang by the penultimate and anal pairs of feet and wave the body about frantically, and then remain quiet, clinging by the three pairs of prolegs, the body arched nearly in the form of the letter S, the anterior feet and legs bent backward beneath the body, which is usually placed parallel with the blade on which it is stationed, but not holding to or touching it. On November 4th, some of the larvæ were observed in the act of moulting, the first time I had observed them to do so, though this was doubtless on account of my not having been able to give them daily attention. It will be observed that these larvæ were now a few days less than a month old. Professor French found the date of last moult to vary from 19 to 25 days from hatching.

My larvæ had now become reduced to six, and by the 19th of November, these varied so greatly in size that I was led to measure the lot, and by so doing found that there were really two series, in point of

size, each series comprising three individuals and measuring in length as follows: 1 inch; $1\frac{1}{16}$ inches; $1\frac{1}{8}$ inches, and $\frac{11}{16}$ inch; $\frac{13}{16}$ inch; and $\frac{3}{4}$ inch. The larva measuring $\frac{11}{16}$ inch moulted on November 19th.

On account of being almost continually absent from home, I was now compelled to turn the larvæ over to my assistant, Mr. C. W. Mally, who gave them nearly all the attention they had throughout the remainder of the time that they were under observation.

After December 1, the larvæ appeared to increase in size very rapidly, the larger ones becoming lighter in color, and could hardly be distinguished from the yellowish and brown blades of grass, more or less eaten, and along which they would stretch themselves and remain for a long time, occasionally moving the head from side to side with a sort of trembling motion. This protective coloration had been observed from the time of the first moult of the larvæ, the brown stripes and greenish background blending with the discoloration of the part of the blades of grass that had been attacked, while the lighter green corresponded with the portions of uneaten epidermis, backed by the green color of the blades behind them. As the larvæ became more aged the colors changed to a more decided brown hue, intermingled with yellowish, and with this change there came a decided disposition to pass more of the time nearer the base of the grass plants, where these colors predominated, than higher up, where the prevailing color was a uniform green. Earlier in the life of the larvæ, the upper portion of the blades of grass were more generally attacked, none being cut off from below and falling down to turn to yellow and brown, while now at this later period, many blades were eaten only for a short distance above the ground and falling down took on the yellow and brown. Whatever might have caused this change of habit, it was certainly not on account of the lower portions of the blades being more tender and succulent, though with the continually increasing bulk of the individual larva there would naturally follow a greater aversion to activity, and a less disposition to climb to the higher portion of the blades of grass. It seems to me that we here have a most interesting case of adaptation, and one that was not anticipated when these observations began.

On December 3 the three larger larvæ began to show signs of uneasiness, crawling about the cages, and again stretched at full length on the side of the same, and again down among the grass, feeding.

December 7, one of the larger larva, which will be hereafter designated as No. 1, and the adult and chrysalis is shown under this number in the illustrations, settled down in a corner of the breeding cage, fas-

tened a few silky threads over itself, a labor which was completed the following day, and passed into the pupal stage, having passed a larval period of, approximately, sixty-one days, and seventy-four days from time of deposition of the egg.

The remaining two of the three larger larvæ crawled down to the bottom of the breeding cage and began constructing their cocoons, but died before pupating. The imago of larva No. 1, issued January 13, 1897, thus giving a pupal period of thirty-five days, and one hundred and nine days from date of oviposition.

Of the series of three smaller larvæ, after December 4, two of them increased in size very rapidly, and, in fact, seemed to be gaining upon those of the first series, while the third, which, so far as could be determined, had continued to be the smaller since the time of measurement on November 19, did not increase in size so rapidly. While the two just mentioned became slightly lighter in color, precisely as had the three larger ones, this one continued to be much smaller and darker in color, the blackish stripes being quite conspicuous.

The first larva of the three smaller ones to pupate will be designated as No. 2, the moth and cocoon being so numbered in the accompanying illustration. This was one of the two light colored larvæ of this series, and began fastening the blades of grass together on the night of December 8, the imago issuing January 19, 1897, after a pupal period of forty-one days, and one hundred and fifteen days from date of oviposition of the egg.

The third larva reared to the adult moth will be designated as No. 3, including adult and cocoon. This was second of the lighter colored of the second and smaller series, and began pupating during the night of December 9, but did not finish doing so until the following day, leaving the blades of grass which it had begun fastening together, with the evident intention of constructing a cocoon therefrom, and appropriated a bit of cotton that happened to be within reach, and constructed its cocoon from that, thus forsaking a natural material for an artificial, and seemingly one of more practical utility. The imago appeared January 23, 1897, after a pupal period of forty-four days, and one hundred and seven days from the deposition of the egg.

The third of this series and the smallest of the larvæ studied, escaped from its breeding cage, December 15, evidently when searching about for a satisfactory place in which to spin its cocoon. It continued to be of a darker color throughout, but had attained to the same size as its fellows. Later, an adult of this species was found dead in the insect-

tary, during the latter part of January, and as this was the only example found and the date of finding corresponds so nearly with that of the appearance of the remainder of the whole series, together with the fact that there was hardly a possibility of a larva having been unintentionally introduced from without, there is little doubt but that this was the imago from the larva which had escaped from its breeding cage. It was very similar to No. 1, being about the same size, but somewhat darker in color. The mother of the whole three being lighter and of the type of No. 2.

About October 10, 1896, Mr. Mally brought in from the fields three larvæ, seemingly nearly full grown, and these were placed on clover and blue grass in a breeding cage in the insectary. About October 22, all three of these formed cocoons similar to the one shown in No. 4, which is composed of three clover leaflets fastened together, while still attached to the petiole, thus making a neat and deceptive case, having three quite conspicuous angles. The weight of the pupa of course caused them to turn downward, but even then they appeared like a drooping, withered leaf, and for this reason very apt to be overlooked. One of these three pupæ was preserved for a cabinet specimen, the second died, while the third transformed December 6, and is shown with cocoon in No. 4.

Of two larvæ brought in from the fields and placed in jelly cups about October 21, one formed a very slight cocoon of silk as shown in No. 5, and the other fastened blades of grass together, as shown in No. 6, notwithstanding both were supplied with grass for food, and hence both had the same material from which to construct their cocoons. The imagos both appeared December 18, 1896.

The latitude of Wooster, Ohio, where these experiments were carried on, is $40^{\circ} 48'$, while that of Carbondale, Illinois, where Professor French studied the species, is about $37^{\circ} 45'$. It will be observed that with him the egg period was less than half as long as with me, while with him the species developed in from 41 to 66 days from the egg, the majority going from 48 to 53 days, with me this period varied from 107 to 115 days. The eggs which furnished the basis for his breedings were deposited August 13, and those which I followed were deposited on September 24 or 25.

I am quite certain that, here in northern Ohio, the insect goes into the winter in the larval stage, as I have observed nearly full grown larvæ crawling about after the middle of November, though hibernation may also occur with pupæ or even adults. In southern Ohio, I have observed seemingly freshly emerged adults early in April. All of my

larvæ upon which these studies are based were kept in the insectary, and in a temperature varying probably from 60° to 75° Fah.

The species is a grass as well as a clover insect, as will be observed from the foregoing, and as the striped body of the larvæ would indicate, but it would seem that the clover leaf is especially desirable as material for constructing the cocoon, and it is just possible that the lack of this building material would account for the great variation in tastes in selecting such as was at hand to supply the place of clover leaves, thus the better illustrating natural selection.

The variation in rapidity of growth I am totally unable to account for, as there was an abundance of food, and the larvæ were never crowded. With the individual variation in size and time required for development in the larvæ, as well as their difference in coloration, together with the equally striking difference in the appearance of the adult, it would seem that in this case at least individual variation offered no very narrow basis for the evolution of forms, which, under a favorable environment, might still further progress through varieties to species. That this may have actually transpired, is witnessed by the exceedingly close resemblance between *Drasteria erectæ* Cram. and *D. crassiuscula* Haw., either one of which might have given origin to the other, through the same course of evolution as that, seemingly, being followed at present by varieties *agricola* G. & R., *ochrea* Grt., and *distincta* Neum., the two latter being considered by Mr. Slingerland as varieties of *D. crassiuscula*. It only requires that these varieties become sterile to each other and the parent stock when crossed, in order for them to become species, as valid as either of the two just mentioned.

EXPLANATION OF PLATES IV AND V.

Fig. 1. *Drasteria erectæ* and cocoon.

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| " 7. | Eggs, enlarged (pl. IV). | | | |
| " 8. | Larva, enlarged (pl. V). | | | |